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Abstract

This paper investigates China's banking system in a post-crisis environment, 2008-2018, focusing on determinants of bank lending. We use a panel of 14 Chinese listed banks, for which there is data over this period. We group these 14 banks into various bank-clusters, classified by ownership and systemic importance. Possible determinants of loan growth are divided into two sets of variables: *bureaucratic variables* and *economic variables*. We find that for individual banks and bank groups bureaucratic variables are very significant and the economic variables have comparatively little influence, which is consistent with the state retraining quite a lot of control. However, pooling of the data gives evidence for the influence of economic variables. The size of the coefficients is similar to the average of the individual banks but they are now significant, reflecting the larger sample size. Thus the pooled estimates are more supportive of the role of bank-specific market forces in determining loan growth.

JEL classifications: E51, P34, C32
Keywords: Loan growth; Listed banks; Bureaucratic effects; Market effects; China

1 Introduction

This paper investigates the determinants of bank lending in China in a post-crisis environment, 2008-2018. We conduct a heterogeneous panel analysis of a panel of 14 Chinese listed banks, for which there is data over the period 2008Q1-2018Q4. These 14 banks represent a large share of China's banking financial system. We group them into various bank-clusters, classified by Chinese government categories and global systemic importance.

Under a market system loan growth responds to stochastic economic shocks to demand and supply and tends to follow a random walk like path, similar to many other financial variables, within regulatory constraints. Under planned systems loan growth is much more predictable. A comparison of the sterling exchange rate with renminbi exchange rate will show

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the difference. In the case of the banks, the planning controls include plan targets, credit restrictions and loan quotas. The possible determinants of loan growth are divided into two sets of variables. The first set, we label *bureaucratic variables*. These include deterministic elements like trends, seasonal effects and dummies representing state directives during the crisis plus a lagged dependent variable reflecting inertia or slow adjustment. The second set we label *economic variables*. These include bank-specific economic factors that in a market system one would expect to influence loan growth. The economic variables we consider are suggested by the US bank regulators financial conditions measures usually summarized as CAMEL: *C*apital adequacy, *A*sset quality, *M*anagement capability, *E*arnings and *L*iquidity, plus some other variables like bank size. We find that for individual banks and bank groups bureaucratic variables are very significant and the economic variables have comparatively little influence, which is consistent with the state retraining quite a lot of control. However, pooling of the data, which constrain the coefficients to be the same across banks within a group, gives more evidence for the influence of economic variables. The size of the coefficients is similar to the average of the individual banks but they are now significant, reflecting the larger sample size. Thus the pooled estimates are somewhat more supportive of the role of bank-specific market forces in determining loan growth. However, the bureaucratic variables remain important.

China's banking financial institutions accounted for 78% of total financial assets in 2008 and 83% in 2018. Commercial banks are the main part of Chinese banking financial institutions and their total assets occupied 78% of the banking financial institutions in 2018, and is therefore a pivotal part of China's financial system. Chinese commercial banks rely on traditional investment tools, predominantly lending, which reached 52% of their total assets in 2018. The evolution of bank lending is hence clearly at the core of recent Chinese financial development. So this paper investigates the determinants of loan growth for 14 listed Chinese commercial banks over the period 2008-2018, the decade after the financial crisis.

China initiated a series of far reaching financial reforms in 1978 in an attempt to transform gradually from a government-controlled financial system to a market-based financial system, which lets the market play decisive role in resource allocation. The main purpose of these reforms has been to increase competition, enhance stability, and improve the performance of the Chinese banking sector; and indeed, competition has increased significantly (Tan & Floros, 2018). As far as the reforms of the financial system are concerned, three important aspects of financial institutional changes are: (i) the reform of the banking system; (ii) the exchange rate reform; and (iii) the rapid development of the capital market (Zuo & Park, 2011). Given the importance of banking to the Chinese economy, reforms of the banking system took a centre stage in the wider reform effort to achieve China's transformation to a market economy. This included the development of a multi-tiered banking system of private and state-owned banks from the pre 1978 banking system, where lending was fascilitated through the People's Bank of China only. In investigating determinants of bank lending in China we hence give an evaluation of the state of this development thus far. The rapid development of China's financial system implied rapid loan growth. There is a debate as to whether this loan growth is justified by market forces or a result of state interventions, which goes to the core of arguments on sustainability of the Chinese banking system. We investigate

this issue.

A crucial function of a financial system is its ability to withstand shocks. Open, market based systems are vulnerable to financial market disruption: Lack of control and interconnectedness of market participants can lead to rapid transmission and amplification of external shocks. The financial crisis of 2008 and following gave an example of unusually large disruption to global financial markets. It was therefore a test to China's developing financial system. Disruptive effects to the global financial system transmitted in large part through bank lending: Across the world the failure of traditional bank-lending channels of monetary transmission prompted the implementation of unconventional monetary policies, such as quantitative easing, by major central banks. Investigating Chinese post-crisis bank lending has important implications for the stability of China's financial system, which in late 2019 was an important policy question.

The remainder of the paper is organized as follows. We present a literature review in Section 2. We described particularly about the 14 Chinese listed banks in Section 3 this paper focuses. We describe the data and variables in Section 4. We discuss the empirical methodology and results in Section 5. Section 5 presents the empirical findings. Section 6 concludes.

2 Literature review

While there is a large literature on the determinants of international bank lending, concerned with distinguishing the external (foreign "push") and internal (domestic "pull") factors, (e.g. Jeanneau & Micu, 2002; De Haas & Van Lelyveld, 2006; Gozgor, 2014; Iwanicz-Drozdowska & Witkowski, 2016), it is not very relevant for Chinese domestic lending. China's banking system is highly controlled by government and banks' lending behaviour follows the lead of government. Similarly, there are a number of studies of the determinants of credit growth in panels of countries which regard China as an observation in their samples, for instance, Takáts (2010) and Gozgor (2014). However, studies including China as an observation ignore the heterogeneity across countries.What is true from other economies and groups of countries may not be true for China.

Another part of the literature is concerned with distinguishing the demand and supply-side factors driving loans growth. Some variables, e.g., lending interest rate, inflation, debt overhang and alternative funding, are usually treated as factors affecting credit demand. Some other macroeconomic variables, e.g., real GDP, unemployment, wages, economic sentiment index, stock exchange, etc. However, it is often difficult to separate macro variables into demand-side or supply-side factors. For example, real GDP drives credit cycles through both supply and demand channels. We focus on bank-specific variable driving loan growth. These variables, such as bank size, capital adequacy, asset quality, earnings, liquidity and funding, will reflect both demand and supply side macroeconomic forces.

The large literature emphasizing the central role of the government on Chinese banking is particularly relevant to our analysis. Firth et al. (2009) point out that a salient characteristic of China's banking sector is the dominant state ownership of banks, which allows for government involvement in the decision making of those banks, and policy lending remains a defining characteristic of the banking system. Liu et al. (2018) point out that the banking system in

China is mostly controlled by the government, and the Chinese capital market and credit supply expansion provide an excellent environment which cannot be replicated in other countries. Firms in China are more bank dependent, which makes them much more sensitive to changes in bank loan supply. Liu & Wray (2010) argue that domestic Chinese banks really do follow the lead of the government, — when encouraged to lend, they do so; when lending is discouraged, they impose self-constraint. Bailey et al. (2011) state that China's banks remain largely constrained by government intervention at different levels and subject to substantial political influences. Zhang & Daly (2011) argue that the government influences the banks' lending behaviour by controlling the amount of lending through quotas and other means to some degree, for example, state-owned banks (policy banks and "big four" state-owned commercial banks) are the major lenders of state-owned enterprises. The SOEs make up a substantial part of the national economy in China (Xu, 2010). So far China's financial system is still a typical "financial repression": banking is at the core of China's financial system; what makes things worse is that most banks are state-owned banks; China's interest rate has been regulated; and China's stock market is still highly regulated (Liu, 2014).

Ru (2018) examines effects of government-directed lending on firms using detailed industrial loan data from China Development Bank (CDB) and finds that CDB industrial loans to state-owned enterprises (SOEs) crowd out private firms in the same industry but crowd in private firms in downstream industries. Liu et al. (2018) examine effectiveness of the government oriented economic stimulus package and the associated increase in bank loans supply by using a panel of Chinese firms over the period 2003-2013 and find that SOEs received more bank loans and resources than non-SOEs. Cheng & Degryse (2010) investigate whether financial development affects local economic growth, and they find that bank development, in particular bank credit, greatly contributes to province growth. There are also research exploring loans allocation in China from the standpoint of banks making loan decisions or from the standpoint of firms accessing loans. For example, Firth et al. (2009) examine how the Chinese state-owned banks allocate loans to private sectors and they find that the banks use commercial judgments to make loan decisions and political connections play a role in gaining access to bank finance. Other examples of research on loans allocation are Cull et al. (2015) and Dong et al. (2016). In addition, for the case of banks in China, some researchers focus on studying determinants of banks' low profitability (García-Herrero et al., 2009); relationships of bank profitability with inflation and economic growth (Tan & Floros, 2012); determinants of banking efficiency (Chen et al., 2005); bank ownership reform and bank performance (Lin & Zhang, 2009); determinants of financial performance (Heffernan & Fu, 2010).

There is also a literature examining the effect of bank lending. Liang & Cao (2007) investigate the time series relationship between property prices and bank lending in China over the period 1999Q1-2006Q2 by using an autoregressive distributed lag framework and find that there only exists unidirectional causality running from bank lending to property prices. Pan & Yu (2008) study empirically the impact of local government intervention, legal enforcement, and financial weakness on the bank loans of the state-owned listing companies controlled by provincial government, and they find that the legal enforcement and financial development at the province level have negative impact on bank credit and debt maturity. Liu & Wray (2010) explore the effects of excessive liquidity on bank lending in China and they

think that it is not excessive liquidity that creates the skyrocketing domestic loan growth. Huang et al. (2015) explore how the bank loans and local amenities explain Chinese urban house prices and he point out that credit drives up property prices after 2008 financial crisis, whereas house prices only influence bank lending before crisis. Mixed results have been obtained because of differences in research perspectives on loans determinants in China, theoretical frameworks, econometric estimation methods, and dataset.

The ties with government vary across bank groups. The government intervenes in various ways including credit quotas, monetary policy, window guidance, etc. Thus it is difficult to measure government intervention. Therefore, many researchers just simply attributed loans growth to government decisions. However, we think that even though the government lending policies dominated, the banking institutions can have some freedom to make decisions according to market rules. Even though government sometimes makes specific lending decisions for banks, it generally shows lending directions macroeconomically and it does not intend to control loans in detail. Especially, the Chinese government has been implementing a series of financial liberation reforms in recent years.

There is overwhelming evidence for other regions and countries that bank-specific factors play an role in determining loans growth. The determining factors of credit fluctuations detected varied across studies, depending on sample and data period. Everaert et al. (2015) analyse demand and supply factors (including bank size, asset quality, financial leverage indicator, liquidity, capital adequacy, and profitability indicator) driving credit cycles in the Central, Eastern, and south-eastern Europe (CESEE) countries by focusing on a large sample of bank-level data on credit growth. Their results of panel data analysis indicate that supply factors, on average and relative to demand factors, gained in importance in explaining credit growth in the post-crisis period. Both CESEE countries and China have undeveloped financial market, but they are quite different in economy size, party and capitalist systems. It is not easy to compare studies about CESEE countries with China. Pham (2015) empirically investigates possible factors including capital requirements, bank profitability, bank asset quality and bank concentration, which drive domestic credit across 146 countries at different levels of economic developments. They find that credit supply is negatively related to capital requirement, exchange rate, index of capital account openness, bank concentration and nonperforming loans; they also find evidence of the country specific effect of economic growth on bank lending; the determinant role of several variables such as inflation, global liquidity, ROE/ROA index on explaining bank credit growth was also explored. There are some recent studies on drivers of domestic credit expansion based on individual countries. Awdeh (2017) investigates causes of credit growth in Lebanon by proposing a panel estimation equation including a set of internal (bank-specific variables including growth of customer deposits, equity to asset ratio, loan-loss-provision, return of assets, and bank size) and external variables (factors reflecting economic environment and developments). The panel data is based on 34 commercial banks over the period 2000 to 2015. Awdeh (2017) finds that deposit growth, GDP growth, inflation, and money supply positively contribute to bank credit to the resident private sector. In contrary, credit risk, lending interest rate, T-bill rate, public borrowing, and remittance inflows decrease loan growth. The impact of one-year lag of each variable was also studied. Tan (2012) explores the determinants of the growth of private sector credit

in Philippines and they find that relatively high net interest margins have been a significant deterrent and deposit expansion also contributes positively to private credit growth, while a larger bank size, bigger bank capitalization, foreign ownership, high overhead costs and presence of corporate taxes all positively contribute to higher net interest margins. These studies show evidence that bank-specific factors play a role in loans growth, but their research results are mixed across regions, sample period, definition of variables, control variables, research methods, etc. In addition, these studies usually include both bank-specific and macroeconomic variables in their models. China is quite different from other regions in country size, economic and political systems, and it will make sense to study bank-specific variables on the basis of balance sheets.

With this background, this study will systematically focus on identifying determinants of China's loan growth on the basis of panel data.

3 The state of China's banking system

This section gives an introduction to Chinese banking institutions, particularly the sample of 14 listed banks with data since the financial crisis.

At the end of 2018, there were 4588 banking financial institutions operating in China, including 6 large commercial banks (Postal Savings Bank of China joined in 2018), 12 joint-equity commercial banks, 134 city commercial banks, etc. In the same year, there were 46 banks listed on Chinese stock exchanges; we focus on the 14 of them, listed before 2009, to allow for long time series. There were 3 others listed in 2010, and the other 29 listed after 2013. On the basis of classification standard of Chinese government, our sample includes 3 groups of banks: 4 large state-owned commercial banks (SOCBs), 7 joint-equity commercial banks (JSCBs), and 3 city commercial banks (CCBs) (see Table 1). Since 2011, the Financial Stability Board has published a list of global systemically important banks (G-SIBs). Our sample includes 3 G-SIBs: Bank of China, China Construction Bank, Industrial and Commercial Bank of China; and 11 other banks which are not global systemically important banks (G-SUIBs). The following shows details of these banks (see Table 1).

Our sample has 4 of the 6 large state-owned commercial banks, which include 3 of the traditional "big four" state-owned commercial banks: Bank of China, China Construction Bank, Industrial and Commercial Bank of China,[1] and Bank of Communications. Large state-owned commercial banks are directly controlled by the state (Ministry of Finance and Cental Huijin Investment Co., Ltd.), which is the first majority shareholder. Zhang & Daly (2011) describe a large degree of government influence on the "big four" state-owned commercial banks. These banks further dominate the banking financial institutions in terms of assets share, capital source, network distribution, and stability. Their total assets comprises 36-51% of banking financial institutions each year from 2008-2017 (see Figure 1). Generally, State-owned banks are guaranteed by the Chinese government and enjoy a high reputation and much social resources. Their relative monopoly position allows them to capture a large market share in terms of assets outstanding. They run various and balanced business all over the

[1] Our sample does not include Agricultural Bank of China, which was listed the Shanghai Stock Exchange in 2010.

country including major cities and most rural areas. Their strong and stable customer base gives them a big advantage in terms of stability of lending and deposit. Of the six large commercial banks in China, the four included in our sample account for 82-83% of total assets each year from 2008 to 2017.

Our sample also has 7 of the 12 joint-equity commercial banks, which includes 5 state-controlled banks which are SOEs: Shanghai Pudong Development Bank, Hua Xia Bank Co., Ltd., China Merchants Bank, Industrial Bank Co., Ltd., and China CITIC Bank; and 2 non-state-controlled banks, which are private-owned enterprises (POEs): Ping An Bank Co., Ltd. and China Minsheng Banking Co., Ltd.. The joint-stock commercial banks run business mainly in large and medium-sized cities and a few county areas. They implement management differentiation strategy, provide unique services, and gradually form their own competitive advantage. Their market share measured by total assets ratio in the banking financial institutions has increased from 14% in 2008 to 18% in 2017 (see Figure 1). Of the 12 joint-equity commercial banks in China, the seven included in our sample account for 80-84% of total assets each year from 2008 to 2017.

Table 1: 14 listed banks.

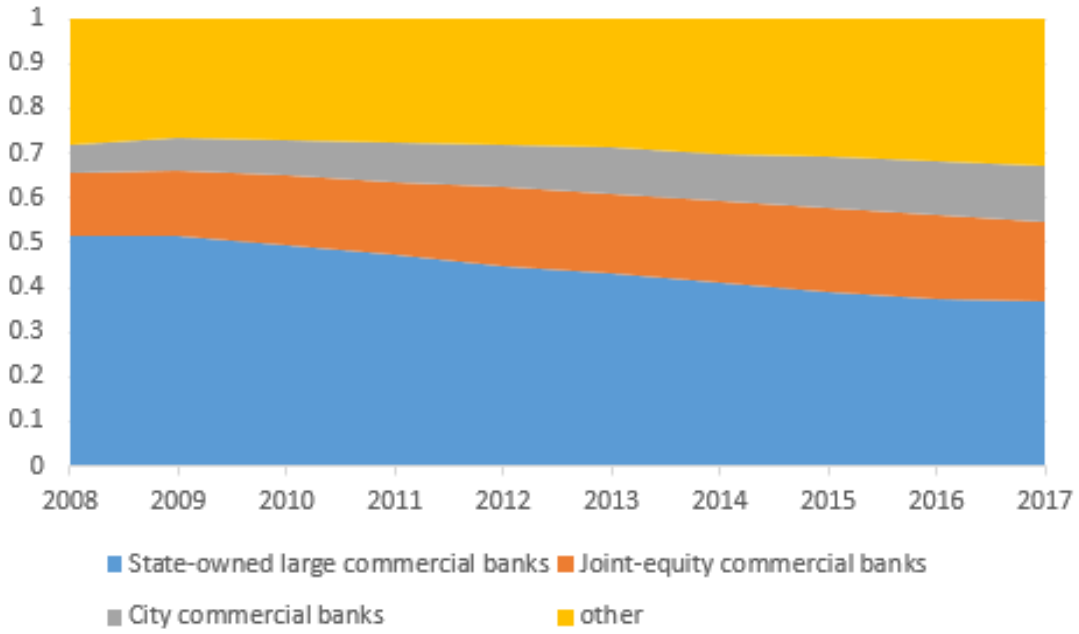
crossid	Stock code	Bank name	Chinese classification	Sytematic importance	Listing time
1	601398	Industrial and Commercial Bank of China Limited	SOCB	G-SIB	27/10/2006
2	601939	China Construction Bank	SOCB	G-SIB	27/10/2005
3	601988	Bank of China	SOCB	G-SIB	01/06/2006
4	601328	Bank of Communications	SOCB	G-SUIB	23/06/2005
5	000001	Ping An Bank Co., Ltd.	JECB	G-SUIB	10/03/1989
6	600000	Shanghai Pudong Development Bank	JECB	G-SUIB	23/09/1999
7	600015	Hua Xia Bank Co., Ltd.	JECB	G-SUIB	12/09/2003
8	600016	China Minsheng Banking Co., Ltd.	JECB	G-SUIB	19/12/2000
9	600036	China Merchants Bank	JECB	G-SUIB	09/04/2002
10	601166	Industrial Bank Co., Ltd.	JECB	G-SUIB	23/01/2007
11	601998	China CITIC Bank	JECB	G-SUIB	19/04/2007
12	601169	Bank of Beijing	CCB	G-SUIB	19/09/2007
13	601009	Bank of Nanjing	CCB	G-SUIB	19/07/2007
14	002142	Bank of Ningbo	CCB	G-SUIB	19/07/2007

Note 1: SOCB refers to the state-owned commercial bank; JECB refers to the joint-equity commercial bank; and CCB refers to the city commercial bank. G-SIB refers to the global systemically important bank and G-SUIB other banks.
Note 2: We got information of sample banks from CSMAR (the China Stock Market Series and the China Listed Firms Research Series), websites, the 2015 Annual Report of China Banking Regulatory Commision, China Financial Development Report (2016; 2017), and the 2017 Annual Report of China Banking Regulatory Commission.

Our sample also includes 3 of 134 city commercial banks including Bank of Ningbo, Bank of Nanjing, and Bank of Beijing. Bank of Ningbo ranks first in the list of city commercial banks (over 300 billion yuan in assets) in the competitiveness evaluation report of China's commercial banks released by The Banker in 2018. City commercial banks were founded gradually since 1995 on the basis of urban credit cooperatives. They mainly offer financial services for local middle and small enterprises and residents. Generally, they supply financial services at provincial level although some have broken regional restrictions. City commercial

banks have diverse ownership. Most city commercial banks have strong ties to their local government and are majorly or wholly state owned.[2] Even though the government is not the largest holder of some city commercial banks, the local government is de facto in control. The market share of city commercial banks has increased from 6% in 2008 to 13% in 2017. Of the 134 city commercial banks in China, the three included in our sample account for 14-16% of total assets each year from 2008 to 2017.

Figure 1: Market (assets) share of banking financial institutions in China, 2008-2017.



Source: The 2017 Annual Report of China Banking Regulatory Commission.

Generally, the number of each type of banking financial institutions is not proportional to its market share. Even though the 14 sample banks occupy only a very small portion of all the 4588 banking financial institutions in terms of the number, they all are the main banking financial institutions with large assets.[3] The total assets of population of large commercial banks, joint-equity commercial banks, and city commercial banks is 169.5 trillion Yuan at end of 2017, and it is 67.15 percent of the total assets of all financial institutions. The total assets of 14 sample banks takes account of 46.52% of that of all financial institutions. Therefore, regarding the market share of banks in the population of banking financial institutions, the selected banks are representative of the total population of banks.

[2] Banking in China, https://en.wikipedia.org/wiki/Banking_in_China.

[3] Rural commercial banks, rural cooperative banks, rural credit cooperations, and village banks have a large population number of 3822, but they usually have a very low market share.

4 Data

As noted in the introduction we distinguish bureaucratic and economic variables. The bureaucratic variables, representing government planning, are deterministic variables like trend, seasonals, and dummy variables for crisis regulations plus a lagged dependent variable to represent inertia. The economic variables are discussed below.

4.1 Economic determinants using CAMEL framework

In this paper, our interest lies in the loan growth of 14 listed Chinese banks. We obtain bank-level data over the period 2008Q1-2018Q4 from CSMAR (the China Stock Market Series and the China Listed Firms Research Series).[4] We also collected additional information online.

The dependent variable in our models is loan growth, which is the percent change of net loans and receivables at quarterly rate. Net loans and receivables is the monetary value of outstanding loans and discounted assets receivables after deducting the provision for impairment at the end of period. We use the CAMEL framework, which was recommended by the U.S. Federal Reserve, to suggest the explanatory variables, reflecting five areas of financial conditions for a financial institution: *C*apital adequacy, *A*sset quality, *M*anagement capability, *E*arnings and *L*iquidity.[5] CAMEL is set out in Table 2, together with the proxies that we use to represent each variable. There is an element of judgment in how one chooses to measure each element in CAMEL and different authors choose different variables. Our choice is not exactly the same as used in the United States. We also add bank size which was suggested to affect loan growth.

Table 2: CAMELS variables.

CAMEL	Variable	Abbr.	Unit	Expected sign
Dependent variable	Growth of Net Loans and Receivables	NLG	1	
Capital Adequacy	Ratio of Equity to Assets	ETA	1	+
Asset quality	Ratio of General Risk Reserves to sum of General Risk Reserves and Net Loans and Receivables	GRRTTL	1	+
Management	Net Profits per Employee	NPTEMP	RMB	+
Earnings	Return on Equity	ROE	1	+
Liquidity	Ratio of Cash to Assets	CTA	1	+
	Ratio of Deposits Due To Customers to Total Assets	DCTTA	1	+

[4] Dungey & Osborn (2019) cited: although there is considerable debate in the literature about the quality of Chinese data, Sinclair (2013) shows that the extent of data revisions is comparable to those for the US; and similarly, Chow (2006) finds official China data to be at least reasonably accurate and are reliable for use in many macroeconomic analyses. The assigned staff members are obligated by law to prepare accurate statistics.

[5] In 1995 the Federal Reserve and the Office of the Comptroller of the Currency replaced CAMEL with CAMELS, adding *S*ensitivity to Market Risk. Sensitivity to market risk is a complex and evolving measurement area, and it primarily to address interest rate risk, the sensitivity of all loans and deposits to relatively abrupt and unexpected shifts in interest rates. Given no available data for individual bank's interest rates for the whole period, 2008Q1-2018Q4, we do not include this in our paper.

In the following, we discuss how CAMEL variables may influence the dependent variable, loan growth, and the expected sign of impacts is shown in Table 2.

4.1.1 Capital adequacy

Capital adequacy is measured as equity to assets ratio. Equity is the money that investors have put into the banks (by buying its stock). It is a potential form of funding (Brinkmeyer, 2015). The equity to assets ratio measures a bank's capital adequacy and indicates a bank's leverage (debt). More specifically, it measures the degree to which a bank is financing its operations through debt versus wholly-owned funds. It reflects the ability of shareholder to cover all outstanding debts in the event of a business downturn.

A high ratio implies the bank is well capitalized and relies little on debt to run its business. Relying too heavily on debt, the bank has to make more interest payments, weakening its financial position and making it vulnerable to a bank run, at which point it won't be able to pay out deposits. Bank loan is a major part of domestic credit. De Lis et al. (2001) find that episodes of strong credit growth tend to go hand in hand with large increases in equity in a sample of industrial countries. This ratio is expected to be positively related to loan growth. Everaert et al. (2015) assess capital adequacy of banks by ratio of equity to net loans and they find that capital adequacy in the previous year has a positive effect on real annual credit growth in Central, Eastern, and Southeastern Europe.

The capital adequacy is hence expected to have a positive effect on loan growth of Chinese banks.

4.1.2 Asset quality

Researchers use the ratio of loan loss reserves (memo) to gross loans to measure asset quality, which indicates how much of the total portfolio has been provided for but not charged off (Kosmidou et al., 2005; World-Bank, 2006; Everaert et al., 2015). Loan loss reserves are accounting entries banks make to cover estimated losses on loans due to defaults and non-payment. Given data availability, we use the ratio of general risk reserves to the sum of general risk reserves and net loans and receivables to measure asset quality of a bank. General risk reserves refers to the risk preparation that a bank extracts from the net profit to make up for the unrecognized potential loss.

Chinese banks assess the potential risk of some risky assets using their own developed models based on the principle of dynamic provision, or by the government requirements. Dynamic provision refers to the counter-cyclical provision method adopted by banks according to the changes of the macroeconomic situation. That is, when the default rate of the risky assets is relatively low in the upward macroeconomic trend, banks make more reserves to increase financial buffers. When the default rate of the risky assets is relatively high in recessions, banks make less reserves and use the accumulated provisions to absorb asset losses. Loans are the major asset for most banks. So the ratio of general risk reserves to the sum of general risk reserves and net loans and receivables measures the asset quality, particularly loan quality: the higher the ratio, the less risky assets, the better the quality of the assets including the loan portfolio.

Asset quality is hence expected to have a positive effect on loan growth because lending is inversely related to risk (Altunbas et al., 2007; Nier & Zicchino, 2008).

4.1.3 Management

Management influences whether a bank possesses the ability to correctly diagnose and respond to financial stress. The category depends on the quality of the business strategy, financial performance areas, and internal control measures. In the business strategy and financial performance areas, it refers to the institution's plans for the next few years, including the capital accumulation rate, growth rate, and identification of the major risks. Internal control measures refers to the its ability to track and identify potential risks. Examples includes information systems, audit programs, and record keeping.

Management is measured as net profits per employee. In CAMEL model studies, Soni (2012) use total debt to total deposits, profit per employee, ROE, and earnings per employee as indicators of management of a bank. Rostami (2015) uses net profit, total assets, total liabilities, total deposits, and total loans of number of branches of each bank. Given the definitions of management, strong correlations of indicators employed by researchers and data availability, we use net profits per employee to measure management.

Net profits per employee is expected to have a positive effect on loan growth of Chinese banks.

4.1.4 Earnings

Earnings are measured as return on equity. Return on equity is equal to net profits divided by balance of shareholders' equity, which measures how profitable a bank uses its capital. It provides a solid indicator of earnings and profitability performance of banks and is a very effective metric for evaluating and comparing banks. ROEs of 15-20% are generally considered to be favorable for purposes of investment.[6]

A higher profitability is a signal of a general improvement of economic conditions. A higher return on equity indicates that a bank is effectively using its capital to generate profits and return the profits to investors at an attractive level. From this point, a higher return on equity can attract more equity and then a bank have a higher capital adequacy which is expected to have a positive effect on loan growth. Low profitability may signal fundamental problems for insurance corporations and may be considered as a leading indicator for solvency problems (Heath, 2013), which we think also works for banks. Intuitively, banks will conceivably lend more as their profitability increases.

Return on equity is expected to have a positive effect on loan growth of Chinese banks.

[6] See Investopedia, https://www.investopedia.com/ask/answers/040815/what-level-return-equity-common-company-banking-sector.asp

4.1.5 Liquidity

Liquidity is measured as ratio of cash to assets. We use information from Financial Dictionary, Investopedia, and the Economic Times to understand liquidity of a bank.[7] Liquidity is the ability of a bank to pay its debts using only its liquid assets. A liquid asset can be easily sold or converted into cash to meet financial obligations on short notice at little or no loss of its value. Funds in checking, cash in banking accounts and marketable securities, such as stocks and bonds, are the most common types of liquid assets for all businesses including banks. So, ratio of cash to assets is an indicator to reflect the degree of a bank's assets liquidity.

Higher available liquidity in the preceding period is expected to facilitate greater credit expansion (Everaert et al., 2015). High liquidity implies that the bank has a good ability to pay its debts. However, it does not mean that, the more liquid assets a bank has, the more benefit it gets. In the operation of banks, they try to expand loans and investments for profit. Meanwhile, banks are required to keep enough liquid assets to pay its debts to avoid the accumulation of liquidity shortfall. Liquidity shortfall can trigger banks' operation risk and even risks in the financial system.

Because lending is inversely related to risk, liquidity measured by cash to assets ratio is expected to have a positive effect on loan growth of Chinese banks.

4.1.6 Funding situation

We use the ratio of total customer deposits to total assets as a measure for a bank's funding situation. This ratio measures what percentage of total assets is supported with customer deposits. Customer deposits refers to savings deposits except due to banks and other financial institutions, which is a insured funding. Short-term funding includes deposits from banks, and other deposits and short-term borrowings, which is uninsured funding. The share of customer deposits in total assets captures the insured funding, while the share of short-term funding in total assets captures the uninsured funding (Brinkmeyer, 2015). Insured funding is relatively cheap and rise of insured funding decreases a bank's cost. Customer deposits is the least expensive funding source for a bank.[8] A higher share of customer deposits means a better funding situation, which might promote bank loans.

A better funding situation of a bank is expected to increase the loan growth.

4.1.7 Bank size

We control for banks' size, using total assets of a bank over total assets of the 14 sample banks. The share of total assets of a bank shows the position of the bank in the banking sector (Micco & Panizza, 2006; Iwanicz-Drozdowska & Witkowski, 2016).

Many researchers measure bank size on the basis of a bank's total assets, but their specific technologies are different. De Haas & Van Lelyveld (2006) use the portion of a bank's

[7] Financial dictionary, http://financial-dictionary.thefreedictionary.com/liquid+asset. Investopedia, http://www.investopedia.com/ask/answers/052515/what-difference-between-banks-liquidity-and-its-liquid-assets.asp. The Economic Times, http://economictimes.indiatimes.com/definition/liquid-asset.

[8] See the Annual Report Pursuant to Section 13 or 15 (d) of the Securities Exchange Act of 1934 (2018): http://investors.cryolife.com/static-files/6ef9d21c-da5c-4d7e-9bba-70c04f8f4612.

total assets in the total assets in the banking sector in a particular country to measure bank size, which is similar to our measurement. There are also researchers who measure bank size by taking the natural logarithm of total assets (Chen & Wu, 2014; Altunbas et al., 2007; Brinkmeyer, 2015; Kim & Sohn, 2017). Everaert et al. (2015) treat bank assets-to-GDP (bank size) as a explanatory variable of credit growth and find that larger banks grow more slowly than smaller ones.

Altunbas et al. (2007) find that bank size seems to be important as large commercial banks appear to be less risky than their smaller counterparts and bigger efficient and inefficient banks also seem to have lower loan loss reserve levels. So, it seems that larger banks have higher loan growth. Banks with a small share may lend aggressively to increase their market stake. On the other hand, banks with a high market share may enjoy their 'monopolistic' position and impose their conditions on the credit market. So Iwanicz-Drozdowska & Witkowski (2016) believe that the influence of the share of a given bank on its credit growth may be non-linear and, most of all, that it is rather the 'category' (e.g., small or quasi-monopolistic) that matters, not the share in quantitative terms. Kim & Sohn (2017) argue that the expected sign of bank size on lending activities is ambiguous. According to the "too big to fail" theory, Kim & Sohn (2017) argue that, large banks have incentives to take more risk amid high expectations of government bailout to prevent systemic risk, thereby enabling supply of more credit. However, large banks can diversify their portfolio by investing in various types of securities and involving themselves in various activities, whereas small banks tend to pursue traditional lending activities. From this perspective, the bank size effect can be negative.

So there is so far no consistent finding about the size effect, but current research shows that bank size makes some difference for loan growth. The effects of bank size on loan growth is expected to depend on the relative strength of its positive and negative effects.

4.2 Data description

Table 3 and 4 present the mean and standard deviation of the variables, which reflects financial conditions of banks, over the period from 2008Q1 to 2018Q4. Figure 2 and Figures 3-10 in the appendix show the patterns of variables. The financial conditions vary across banks and groups of banks.

Comparing bank groups classified by Chinese standard, on average, state-owned commercial banks are the largest and have the lowest loan growth (3.25%). This is in line with state-owned commercial banks having the lowest general risk reserve ratio, net profit per employee, as well as liquidity measured by cash-to-assets. State-owned commercial banks have the highest capital adequacy and a good situation with respect to their insured funding measured by the share of customer deposits in total assets. State-owned commercial banks rely on traditional investment (loans) and funding instruments (customer deposits). For all variables excluding ROE and bank size listed in Table 4, state-owned commercial banks shows stability in terms of their smallest standard deviations among three bank groups. Joint-equity commercial banks have an average loan growth of 4.35%. On average estimates for joint-equity commercial banks are in between large state-owned commercial banks and city commercial banks for all variables, excluding that joint-equity commercial banks have the lowest capital adequacy and highest ROE. But they display the highest standard deviation for ROE

and share of customer deposits in total assets. City commercial banks, which are smaller than the other banks, have the highest loan growth (5.64%), as well as general risk reserves ratio, net profit per employee, and lead in terms of liquidity. But City commercial banks have the lowest ROE with a small standard deviation and insured funding share. Standard deviations for city commercial banks' loan growth, capital adequacy, general risk reserves ratio, net profit per employee, and cash-to-assets, are the highest among all bank groups.

Comparing global systemically important banks (G-SIBs) with other banks, G-SIBs have, on average, lower loan growth (3.2%), general risk reserve ratio, net profit per employee, and poorer liquidity. G-SIBs have higher average capital adequacy, ROE, and share of customer deposits in total assets and bank size. Tn terms of standard deviation, G-SIBs shows more stability for every variable excluding bank size listed in Table 4.

Looking at graph 2 for the 14 banks, we generally observe a downward trend and, as well as seasonal patterns, and substantial outliers for loan growth during the global financial crisis. An exception is Ping An Bank Co., Ltd., which shows a spike in a different time, 2011Q3. The sharp loan growth in these years is associated with the government oriented economic stimulus package after financial crisis (Liu et al., 2018). This state intervention can be seen as an example of a planned or bureaucratic pattern, that does not respond to short term economic variables. Generally descriptive analysis, shows a lot of movement in other variables, that do not seem to be related to loan growth. Examples for this are big movements in capital adequacy and big jumps in general risk reserve between 2012 and 2013. In 2012, the Ministry of Finance of the P.R. China increased general risk reserve balance requirements from 1% to 1.5% of the ending balance of risky assets from July 2012 (it should not be lower than 1% between July 2005 and June 2012.), which is phased in over 5 years for financial institutions. This is why the general risk reserve proportion has jumps. We include a dummy for this jump in general risk reserve but it has not significant effect on loan growth. There are strong seasonality in management variable (net profit margin per employee) and earning variable (return on equity) and small seasonality in other variables. Cash-to-assets ratio moves around quite a lot. This raises a question about how much influence the economic variables have on loan growth. So looking at the graphs, we see a fairly simple deterministic pattern in loan growth despite a large variations in the economic variables that are would expect to influence loan growth. This suggests that the planning process may be the main influence. These are based on graphs, we need to look at the regressions.

Table 5 illustrates the correlation matrix between variables from 2008Q1 to 2018Q4. All the correlations are smaller than 0.5 excluding: the correlations of general risk reserve ratio and customer deposits to assets, and of ROE and net profits per employee.

Table 3: CAMEL variables, mean.

crossid and groups of banks	Dependent variable	C	A	M	E	L		Bank size	
	NLG	**ETA**	**GRRTTL**	**NPTEMP**	**ROE**	**CTA**	**DCTTA**	**BS**	**TA (trillion CNY)**
Pooled 14 listed banks	0.0431	0.0630	0.0177	457221	0.1099	0.0708	0.6823	0.0714	5.52
Individual banks									
1	0.0307	0.0686	0.0165	341439	0.1198	0.0566	0.7814	0.2469	18.50
2	0.0329	0.0697	0.0153	368932	0.1233	0.0339	0.7948	0.1999	15.16
3	0.0325	0.0710	0.0153	321931	0.0989	0.0797	0.7272	0.1837	13.83
4	0.0340	0.0655	0.0162	400696	0.0999	0.0423	0.6699	0.0754	5.83
5	0.0524	0.0546	0.0167	356767	0.1004	0.0836	0.6906	0.0215	1.81
6	0.0437	0.0556	0.0164	577362	0.1202	0.0605	0.6633	0.0448	3.63
7	0.0384	0.0513	0.0171	295774	0.0957	0.0874	0.6759	0.0204	1.59
8	0.0399	0.0600	0.0202	477359	0.1161	0.0571	0.6526	0.0416	3.41
9	0.0408	0.0620	0.0164	500569	0.1285	0.0874	0.7196	0.0501	3.97
10	0.0463	0.0547	0.0201	531386	0.1269	0.0861	0.5470	0.0438	3.66
11	0.0430	0.0677	0.0173	485725	0.0962	0.0741	0.7222	0.0439	3.55
12	0.0482	0.0669	0.0205	758575	0.1039	0.1038	0.6557	0.0161	1.33
13	0.0648	0.0715	0.0240	550359	0.0974	0.0335	0.6374	0.0062	0.55
14	0.0563	0.0635	0.0152	434219	0.1111	0.1059	0.6141	0.0058	0.51
Chinese groups of banks									
SOCBs: 4 large state-owned commercial banks	0.0325	0.0687	0.0158	358249	0.1105	0.0531	0.7433	0.1765	13.33
JECBs: 7 joint-equity commercial banks	0.0435	0.0580	0.0177	460706	0.1120	0.0766	0.6673	0.0380	3.09
CCBs: 3 city commercial banks	0.0564	0.0673	0.0199	581051	0.1041	0.0811	0.6357	0.0094	0.80
Global groups of banks									
G-SIBs: 3 global systemically important banks	0.0320	0.0698	0.0157	344101	0.1140	0.0567	0.7678	0.2102	15.83
G-SUIBs: 11 other banks	0.0462	0.0612	0.0182	488072	0.1088	0.0747	0.6589	0.0336	2.71

Table 4: CAMEL variables, standard deviation.

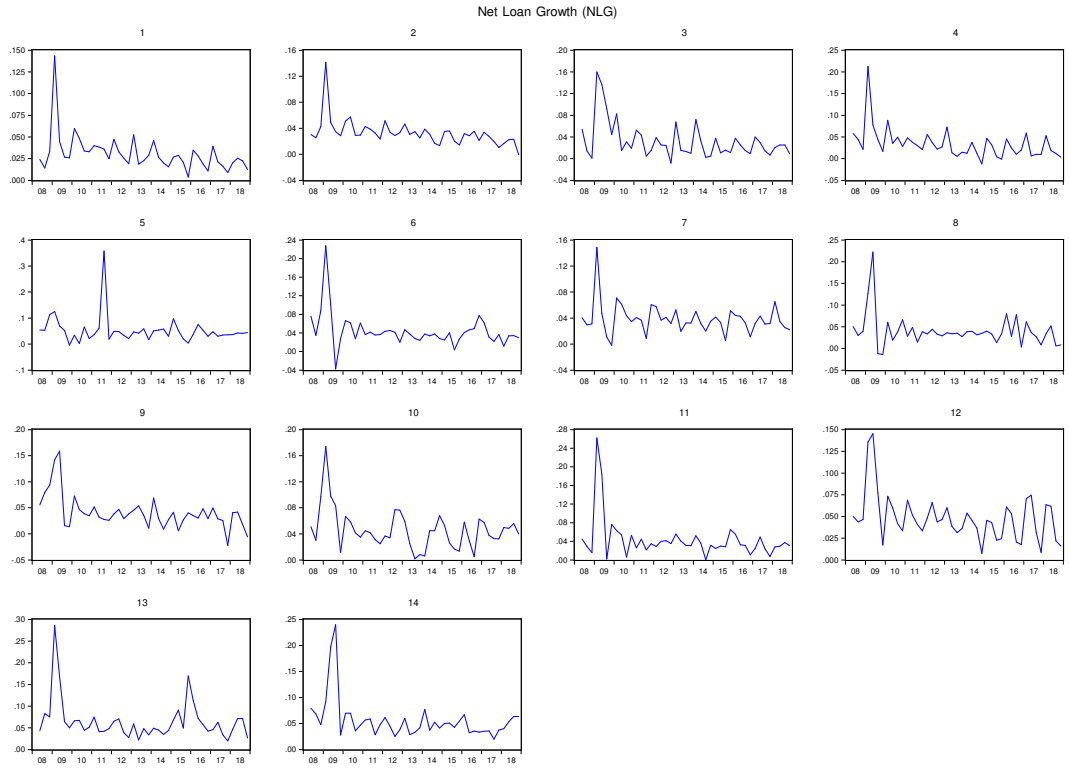
crossid and groups of banks	Dependent variable	C	A	M	E	L		Bank size	
	NLG	**ETA**	**GRRTTL**	**NPTEMP**	**ROE**	**CTA**	**DCTTA**	**BS**	**TA (trillion CNY)**
Pooled 14 listed banks	0.0367	0.0126	0.0063	264803	0.0502	0.0393	0.0956	0.0762	6.23
Individual banks									
1	0.0214	0.0099	0.0035	170377	0.0532	0.0135	0.0355	0.0214	5.69
2	0.0205	0.0079	0.0037	178915	0.0516	0.0101	0.0385	0.0113	5.10
3	0.0341	0.0081	0.0039	160580	0.0420	0.0204	0.0214	0.0140	4.37
4	0.0357	0.0095	0.0055	199766	0.0452	0.0132	0.0622	0.0016	2.23
5	0.0540	0.0124	0.0040	189507	0.0488	0.0268	0.0615	0.0058	1.03
6	0.0366	0.0128	0.0060	294477	0.0608	0.0258	0.0995	0.0062	1.73
7	0.0233	0.0143	0.0034	160776	0.0473	0.0371	0.0604	0.0008	0.65
8	0.0375	0.0069	0.0076	230781	0.0512	0.0344	0.0951	0.0071	1.75
9	0.0323	0.0097	0.0045	250117	0.0562	0.0204	0.0571	0.0040	1.72
10	0.0308	0.0077	0.0084	258767	0.0559	0.0331	0.0704	0.0099	1.99
11	0.0444	0.0070	0.0063	219298	0.0431	0.0297	0.0879	0.0063	1.69
12	0.0275	0.0071	0.0064	420828	0.0423	0.0316	0.0949	0.0030	0.70
13	0.0463	0.0180	0.0084	255475	0.0399	0.0114	0.0305	0.0026	0.40
14	0.0400	0.0112	0.0065	211246	0.0457	0.0777	0.0704	0.0020	0.33
Chinese groups of banks									
SOCBs: 4 large state-owned commercial banks	0.0285	0.0091	0.0042	178953	0.0491	0.0228	0.0647	0.0645	6.48
JECBs: 7 joint-equity commercial banks	0.0380	0.0116	0.0061	248202	0.0534	0.0321	0.0946	0.0127	1.79
CCBs: 3 city commercial banks	0.0390	0.0133	0.0080	335179	0.0428	0.0591	0.0720	0.0054	0.63
Global groups of banks									
G-SIBs: 3 global systemically important banks	0.0259	0.0087	0.0037	169924	0.0500	0.0241	0.0437	0.0313	5.41
G-SUIBs: 11 other banks	0.0386	0.0067	276975	0.0501	0.0416	0.0925	0.0874	0.0210	2.14

Note: TA represents total assets.

Table 5: Correlation coefficients, pooled data for 14 banks.

	NLG	ETA	GRRTTL	NPTEMP	ROE	CTA	DCTTA	BS
NLG	1	-0.15	-0.23	-0.28	-0.29	0.04	-0.10	-0.18
ETA	-0.15	1	0.26	0.16	-0.19	-0.20	-0.05	0.32
GRRTTL	-0.23	0.26	1	0.38	-0.11	-0.33	-0.64	-0.18
NPTEMP	-0.28	0.16	0.38	1	0.63	-0.01	-0.33	-0.21
ROE	-0.29	-0.19	-0.11	**0.63**	1	0.09	0.13	0.07
CTA	0.04	-0.20	-0.33	-0.01	0.09	1	0.08	-0.22
DCTTA	0.10	-0.05	**-0.64**	-0.33	0.13	0.08	1	0.49
BS	-0.18	0.32	-0.18	-0.21	0.07	-0.22	0.49	1

Figure 2: NLG: Loan growth at quarterly rate.



Note: The number at top of each subgraph corresponds to the crossid of each bank listed in Table 1.

5 Research methods and results

The objective of our analysis is to determine the extent to which the loan growth of Chinese banks reflects government intervention or market forces as reflected in the bank specific determinants discussed above.

As noted above the government intervenes in various ways including credit quotas, monetary policy, window guidance, etc. Thus it is difficult to measure government intervention.

Therefore, many researchers simply attributed loans growth to Chinese government decisions. However, we think that even though the government lending policies make difference, the banking institutions can have some freedom to make decisions according to market rules. Even though the state sometimes intervenes through specific lending decisions for banks, it typically gives lending directions macroeconomically and does not intend to control banks' lending operations in detail. We use some variables that we will label *bureaucratic variables* to represent possible government actions plus some bank specific variables that we will label *economic variables*. We will then ask about the respective contribution of these two sets of variables. The bureaucratic variables include deterministic elements like trends, seasonal terms and dummies representing state directives during the crisis plus a lagged dependent variable reflecting inertia or slow adjustment. The economic variables include bank-specific economic factors that, in a market system, one would expect to influence loan growth. Economic variables considered follow the CAMEL approach outlined above.In choosing our model we will answer: Which variable should be included in the final model specifications; how many lags should be included; and how much heterogeneity is there in the banks and groups of banks?

Our baseline model has a vector of independent variables, x_i, which are either current or lagged one period to reduce the endogeneity, plus the lagged dependent variable to allow for any slow adjustment. For the homogeneous slope model we employ fixed-effects within estimators. The homogeneous slope current economic variables model is

$$\begin{aligned} NLG_{it} = \alpha_i + \beta^{'} x_{i,t} + \delta^{'} D9Q(q) + \rho DB511Q3 \\ + \sigma^{'} @SEAS(q) + \phi @TREND + \gamma NLG_{i,t-1} + v_{it}. \end{aligned} \tag{5.1}$$

NLG_{it} is the dependent variable, loan growth; x_{it} gives a vector of economic variables including equity to assets (ETA), general risk reserves to total assets (GRRTTA), net profits per employee (NPTEMP), ROE, cash to assets (CTA), customer deposits to total assets (DCTTA), and bank size (BS); $D9Q(q), q = 1,2,3$ capture outliers in loan growth in 2009Q1, 2009Q2, and 2009Q3, respectively; $DB511Q3$ captures the outlier in loan growth of Ping An Bank Co., Ltd. in 2011Q3; $@SEAS(q), q = 1,2,3$ capture seasonal effects; $@TREND$ is a trend term; α_i is a vector of bank specific constants v_{it} is an error term. $\beta^{'}$ is a vector of coefficient of variables $x_{i,t}$, $\delta^{'}$ of $D9Q(q)$, ρ of $DB511Q3$; $\sigma^{'}$ of $@SEAS(q)$, ϕ of $@TREND$, and γ of $NLG_{i,t-1}$.

The homogeneous slope lagged economic variables model is

$$\begin{aligned} NLG_{it} = \alpha_i + \beta^{'} x_{i,t-1} + \delta^{'} D9Q(q) + \rho DB511Q3 \\ + \sigma^{'} @SEAS(q) + \phi @TREND + \gamma NLG_{i,t-1} + v_{it}. \end{aligned} \tag{5.2}$$

The heterogeneous slope lagged economic variables model involves estimating the model for each individual bank:

$$\begin{aligned} NLG_{it} = \eta_i + \beta_i^{'} x_{i,t-1} + \delta_i^{'} D9Q(q) + \rho_i DB511Q3 \\ + \sigma_i^{'} @SEAS(q) + \phi_i @TREND + \gamma_i NLG_{i,t-1} + v_{it}. \end{aligned} \tag{5.3}$$

5.1 Pooled fixed effects panel regressions

5.1.1 Homogeneous model specification

We explain loan growth with the variables suggested by the CAMEL approach as well as bank size and bureaucratic variables. We start using a general specification of 7 variables, which we subsequently reduce to 4 economic variables following a stepwise selection procedure and economic analysis. Models are re-evaluated throughout the selection procedure using information criteria, tests for omitted variables, and economic judgment.

Table 6 shows fixed effects panel estimations. The general fixed effect specification (GEQ1) includes all variables illustrated by the homogeneous slop current economic variables model (5.1): 7 economic variables plus 3 seasonals, a trend, 3 dummies and a lagged dependent variable. The specific specification (SEQ1) gives a specification obtained after stepwise dropping least significant variables until all variables are significant. Both information criteria, Akaike info criterion (AIC) and Schwarz criterion (BIC), suggest the specific specification SEQ1 rather the general specification GEQ1.

There may be reverse causality from loan growth of banks onto economic variables. To address this endogeneity, we used lagged values of economic variables. Our dynamic general model (5.2) therefore contains the 7 economic variables lagged by one quarter plus 3 seasonals, a trend, 3 dummies and a lagged dependent variable. The specific specification, SEQ2a, gives a specification obtained after stepwise dropping least significant variables until all variables are significant excluding lagged loan growth and the constant.[9] Comparing model specifications, SEQ1 and SEQ2, AIC prefers the homogeneous lagged economic variables model and BIC the current economic economic variables one. Once we drop the insignificant lagged loan growth from the lagged economic variables specific model (SEQ2a), BIC turns to suggest the lagged economic variables model.

Whilst the preceding variable selection was purely based on econometric criteria, we select homogeneous lagged economic variables specification, SEQ2b, as baseline specification, by applying further analytic judgment: Net profit margin per employee on loans growth is dropped despite its significance, given an effect size that is approximately zero. We are further interested in evaluating the effects of liquidity on loans growth and hence include cash to assets ratio in the specification SEQ2b although it is insignificant.

5.1.2 Results

Based on homogeneous lagged economic variables specifications, bank lending is significantly affected by a combination of economic and bureaucratic variables. Strikingly, the combined impact of economic variables out-sizes that of deterministic factors by roughly a factor three. Effects of equity and risk reserves ratios are particularly strong and positive as expected. In the homogeneous current economic variables specifications economic factors turn largely insignificant, apart from ETA, which has a relatively large effect on bank lending, albeit only weakly significant.

[9] Although lagged loan growth is insignificant in the lagged economic variables model. We retain it, so we can compare between specifications.

Table 6: General to specific estimations, coefficients. Dependent variable: NLG; Method: Fixed Effects Panel Least Squares.

Regressor	GEQ1	SEQ1	Regressor	GEQ2	SEQ2a	SEQ2b
ETA	**0.223***		ETA(-1)	**0.547*****	**0.543*****	**0.510*****
GRRTTL	-0.344		GRRTTL(-1)	**0.733*****	**0.687*****	**0.588***
NPTEMP	-6.57E-09		NPTEMP(-1)	**-1.88E-08*****	**-2.21E-08*****	
ROE	0.028		ROE(-1)	**0.145****	**0.123*****	**0.131***
CTA	-0.051		CTA(-1)	0.036		0.035
DCTTA	0.016		DCTTA(-1)	0.014		
BS	0.140		BS(-1)	0.001		
C	0.011	**0.038*****	C	-0.028	-0.007	-0.020
@SEAS(1)	**0.019****	**0.019*****	@SEAS(1)	**0.017*****	**0.018*****	**0.015*****
@SEAS(2)	**0.010***	**0.008*****	@SEAS(2)	**0.015****	**0.011*****	**0.021*****
@SEAS(3)	0.000		@SEAS(3)	0.003		**0.006***
@TREND	-0.0002	**-0.0004*****	@TREND	**-0.0005****	**-0.0006*****	**-0.0006*****
D9Q1	**0.113*****	**0.112*****	D9Q1	**0.108*****	**0.107*****	**0.110*****
D9Q2	**0.070*****	**0.068*****	D9Q2	**0.073*****	**0.073*****	**0.072*****
D9Q3	0.009		D9Q3	**0.013***	**0.013***	**0.014****
DB511Q3	**0.319*****	**0.320*****	DB511Q3	**0.322*****	**0.324*****	**0.320*****
NLG(-1)	0.024	**0.056***	NLG(-1)	0.037	0.036	0.037
R^2	0.65	0.65	R^2	0.67	0.66	0.66
MLL	1416.40	1411.22	MLL	1426.33	1424.76	1423.31
AIC	-4.716	-4.729	AIC	-4.749	-4.758	-4.753
BIC	-4.492	-4.572	BIC	-4.526	-4.564	-4.559
DW	1.94	1.99	DW	1.94	1.95	1.94

Note 1: GE indicates the general model. SE indicates the specific model. First block current economic variables and second block lagged.
Note 2: * denotes significance at the 10% level, ** at the 5% level, and *** at the 1% level.

5.2 Heterogeneity in the banks and groups of banks

5.2.1 Sample selection and model specification

Preceding results give fixed-effects estimates that are pooled for all 14 banks. This allows to control for unobserved heterogeneity in intercepts, whilst taking advantage of the full sample of observations available. But large degree of heterogeneity across banks can result in biased pooled estimates. We therefore estimate the heterogeneity across estimates explicitly in models for individual banks (see Table 8) on the basis of the baseline specification SEQ2b. We further cluster banks with similar characteristics groups, which gives more efficient estimates whilst avoiding some of the bias present in the pooled panels (see Table 8). Table 10 in the appendix shows diagnostic tests for the baseline general specifications, which suggests these specifications for the individual banks are reliable.

Banks are clustered along two dimensions: Chinese groups distinguished mainly by the government (large state-owned commercial banks (SOCBs), joint-equity commercial banks (JSCBs), and city commercial banks (CCBs)) and global groups by systemic importance (global

systemically important banks (G-SIBs), and others (G-SUIBs)). The pooled general model uses the usual standard errors. If White heteroskedasticity robust standard errors are used, they are larger and only ETA(-1) is significant at the 10% level.

We compare models based on sums of information criteria for individual banks and bank groups. Given the loss of efficiency as we reduce sample sizes, we employ further stepwise elimination of insignificant variables, which further reduces parameters and retains comparatively high degrees of freedom (see Table 9). Results suggested in the model selection stage are ambiguous (see Table 7): For the baseline specific models, the AIC and BIC both suggest individual bank as samples. For baseline general models, BIC prefers samples clustered by global groups, whilst AIC again indicates individual banks. The information criteria reflect fit as measured by Log likelihood and parsimony as reflected in the number of parameters. BIC penalizes the number of parameters more and hence reflects the difference in sample size to a greater extend. Moving from baseline general to specific models for individual banks means that there is a large reduction in the number of parameters from 183 to 83, for the Chinese bank groups from 53 to 39, and for the global groups from 40 to 32. Given this large difference in parameters applied to relatively small samples, we tend to err on the side of model parsimony and regard the choice indicated by BIC as more reliable.

Table 7: AIC and BIC

	Baseline general specifications				**Baseline specific specifications**			
	MLL	**k**	**BIC**	**AIC**	**MLL**	**k**	**BIC**	**AIC**
Fixed effects panel of 14 banks	1423.91	27	1337.82	1396.91	1423.91	27	1337.82	1396.91
Individual banks	1775.03	183	1191.56	**1592.03**	1760.35	83	**1495.72**	**1677.35**
Chinese groups	1500.77	53	1331.79	1447.77	1520.48	39	1396.13	1481.48
Global groups	1468.16	40	**1340.62**	1428.16	1491.47	32	1389.45	1459.47

5.2.2 Results

Given the further reduction in considered covariates, we report results for baseline general and specific models separately. Results are given in tables 8 and 9, respectively.

5.2.2.1 Baseline general models Table 8 gives results for regressions on individual banks and bank groups using baseline general specifications. Results are similar to general specifications for pooled estimates. Most significant effects are through deterministic terms, particularly the first seasonal dummy, SEAS(1), and the first crisis dummy, D9Q1, which indicates a significant degree of state intervention affecting lending growth. This notwithstanding we find significant effects of bank specific market factors for clustered bank groups. The state intervention could be explained by the 4-trillion-yuan stimulus package adopted by the Chinese government. In September 2008, after the outbreak of the global financial crisis, China's economic growth slowed down rapidly, with negative exports growth and a large number of migrant workers returning home. The economy was at risk of a hard landing. In response to this crisis, the State Council approved a plan to invest 4 trillion yuan in infrastructure and

social welfare by the end of 2010. The Chinese government launched ten measures, for example, providing funds for infrastructure projects and housing developments, in November 2008 to further expand domestic demand and promote steady and rapid economic growth. According to preliminary calculations, the implementation of these ten measures would require an investment of about 4 trillion yuan by the end of 2010.

Accordingly, market factors, particularly equity ratios and risk buffers, significantly affect joint-equity commercial banks, which are partly privatised, as well as systemically unimportant banks, which excludes the three largest state-owned commercial banks. To find large state-owned commercial banks being less exposed to market forces is unsurprising, given that they benefit from being too big to fail, and are more exposed to policy decisions rather than market factors.

In terms of relative contribution of market and bureaucratic variables, the former tend to be larger in size but are generally less significant, particularly for estimates of individual banks. Here, a lack of efficiency given the lack of available data appears decisive. But given the more efficient estimates for bank groups, we do find significant evidence for the impact of market dynamics. Where significant, the effect of market factors again outsizes that of bureaucratic variables by a large margin.

5.2.2.2 Baseline specific models Table 9 applies a further stepwise elimination of insignificant variables as outlined before. This tackles the problem of efficiency that is present for individual bank estimates and requires a more parsimonious approach. We apply the elimination to both, market and bureaucratic variables. Results nor indicate a more significant impact of market variables, which is generally in line with previous results. Most privately capitalised banks increase lending given higher equity ratios and risk-buffers, whilst some cases of state-owned commercial banks suggest the opposite. In particular for Bank of Communications, there is a significant negative effect of risk buffers and return on equity on lending behaviour, which suggests lending decisions driven by policy considerations not commercial factors.

Findings for bank groups validate previous results. Furthermore the coefficient on ETA(-1) for city commercial banks is now significant, which reiterates the importance of market factors for banks which has a relatively diverse ownership structure.

Table 8: Baseline general specifications, coefficients. Dependent variable: NLG; Method: Panel Least Squares.

Regressors	ETA(-1)	GRRTTL(-1)	ROE(-1)	CTA(-1)	C	@SEAS(1)	@SEAS(2)	@SEAS(3)	@TREND	D9Q1	D9Q2	D9Q3	NLG(-1)	DB511Q3	R^2	MLL	DW
Fixed Effects Panel:																	
14 banks	**0.510*****	**0.588***	**0.131****	0.035	-0.020	**0.015*****	**0.021*****	**0.006***	**-0.001*****	**0.110*****	**0.072*****	**0.014****	**0.320*****	0.037	0.66	1423.91	1.94
Individual banks (crossid, heterogeneous panel estimation):																	
1	-0.598	-0.042	0.029	-0.021	0.058	**0.021*****	0.014	0.004	0.000	**0.098*****	0.004	-0.005	0.028		0.91	153.58	2.04
2	-0.083	0.345	0.067	0.128	0.016	**0.016*****	0.018	0.007	-0.001	**0.086*****	-0.008	0.000	0.120		0.92	155.46	1.99
3	-0.300	0.479	0.248	-0.143	0.002	**0.032*****	0.029	0.013	0.000	**0.126*****	**0.100*****	**0.058*****	0.181		0.89	128.98	2.54
4	-0.324	**-2.936**	-0.350	-0.300	0.152	**0.048*****	-0.005	0.002	0.000	**0.161*****	**0.082****	0.017	**-0.338***		0.92	133.27	2.24
5	**2.714****	**4.048***	0.365	0.007	**-0.166***	-0.004	0.041	0.027	**-0.003*****	**0.150*****	**0.054***	0.030	**0.316*****	-0.024	0.90	110.36	1.61
6	-1.096	1.583	0.049	0.080	0.060	-0.001	0.008	-0.013	0.000	**0.152*****	0.003	**-0.094*****	0.182		0.87	123.14	1.98
7	0.926	2.696	0.195	-0.119	-0.037	0.013	0.025	0.002	**-0.002***	**0.098*****	0.009	-0.015	-0.067		0.75	127.57	2.24
8	0.825	1.281	-0.157	0.134	-0.008	**0.019***	-0.005	-0.002	-0.001	**0.077*****	**0.204*****	0.008	-0.155		0.83	116.15	2.16
9	1.743	1.832	0.114	-0.086	-0.069	**0.021****	0.018	0.018	**-0.002*****	**0.062*****	**0.113*****	-0.025	0.074		0.83	122.04	2.00
10	1.270	0.636	**0.545****	**0.578*****	**-0.194****	-0.018	**0.048*****	0.010	0.001	**0.083*****	**0.058****	**0.068*****	0.222		0.78	118.05	1.69
11	-0.151	0.611	-0.194	-0.018	0.082	0.008	-0.011	-0.017	-0.001	**0.211*****	**0.146*****	-0.028	-0.050		0.90	120.08	1.75
12	0.619	-1.095	0.221	0.029	-0.033	**0.036*****	**0.050****	0.017	0.000	**0.058*****	**0.080*****	**0.037****	-0.010		0.90	138.75	1.62
13	0.508	1.766	-0.236	0.249	-0.003	0.005	-0.020	-0.019	-0.001	**0.201*****	0.032	-0.019	0.309		0.76	99.13	1.98
14	0.427	0.952	0.044	-0.038	0.021	**0.014***	0.009	-0.004	-0.001	0.019	**0.143*****	**0.206*****	-0.065		0.92	128.46	1.24
Mean	0.463	0.868	0.067	0.034	-0.009	0.015	0.016	0.003	-0.001	0.113	0.073	0.017	0.053	-0.024			
Std. Dev.	1.006	1.654	0.245	0.207	0.092	0.017	0.022	0.013	0.001	0.056	0.064	0.068	0.184				
Groups of banks (Fixed Effects):																	
SOCBs	-0.078	-0.454	0.038	**0.163****	0.017	**0.030*****	0.013	0.005	0.000	**0.106*****	**0.024****	**0.015***	0.123		0.80	492.32	2.02
JSCBs	**0.869*****	**0.885***	**0.139****	0.053	**-0.033***	**0.007***	**0.019*****	0.005	**-0.001*****	**0.121*****	**0.091*****	-0.009	**0.320*****	-0.032	0.70	719.04	2.01
CCBs	0.410	0.951	-0.069	0.006	0.011	**0.021****	0.006	-0.004	-0.001	**0.094*****	**0.094*****	**0.068*****	0.101		0.62	289.40	1.84
G-SIBs	0.293	0.500	0.050	**0.213****	-0.022	**0.026*****	0.010	0.004	**-0.001***	**0.088*****	0.011	0.014	**0.262*****		0.80	381.31	1.91
G-SUIBs	**0.535*****	**0.680***	**0.130****	0.033	-0.018	**0.013*****	**0.020*****	0.005	**-0.001*****	**0.115*****	**0.085*****	0.013	**0.321*****	0.019	0.65	1086.85	1.95

Note: * denotes significance at the 10% level, ** at the 5% level, and *** at the 1% level.

Table 9: Baseline specific specifications, coefficients. Dependent variable: NLG; Method: Panel Least Squares.

Regressors	ETA(-1)	GRRTTL(-1)	ROE(-1)	CTA(-1)	C	@SEAS(1)	@SEAS(2)	@SEAS(3)	@TREND	D9Q1	D9Q2	D9Q3	NLG(-1)	DB511Q3	R^2	MLL	DW
Fixed Effects Panel:																	
14 banks	**0.510*****	**0.588***	**0.131****	0.035	-0.020	**0.015*****	**0.021*****	**0.006***	**-0.001*****	**0.110*****	**0.072*****	**0.014****	**0.320*****	0.037	0.66	1423.91	1.94
Individual banks (crossid):																	
1	**-0.685*****				**0.068*****	**0.021*****	**0.010*****			**0.097*****					0.90	155.01	1.92
2				**0.211***	**0.031*****	**0.015*****	**0.009*****		**-0.001*****	**0.088*****					0.89	154.80	1.77
3					**0.007***	**0.039*****				**0.113*****	**0.084*****	**0.045****	**0.287*****		0.87	125.85	2.63
4		**-2.545*****	**-0.181*****		**0.079*****	**0.044*****				**0.150*****	**0.028****				0.89	131.02	2.41
5		**4.640****				0.000			**-0.002****	**0.072*****				**0.317*****	0.86	106.98	1.87
6	**-0.588****				**0.068*****			**-0.013****		**0.159*****		**-0.097*****	**0.216*****		0.86	121.15	2.01
7	**1.107****	**4.082*****	**0.319*****	**-0.124***	**-0.073****		**0.031*****		**-0.002*****	**0.106*****					0.73	128.85	2.25
8			**-0.128***		**0.050*****	**0.022****				**0.080*****	**0.202*****		**-0.192****		0.81	112.96	2.06
9	**1.774**	**1.900*****			**-0.051****	**0.017*****			**-0.003*****	**0.073*****	**0.121*****				0.80	121.75	1.95
10	**1.747*****		**0.244*****	**0.478*****	**-0.132*****		**0.023****			**0.097*****	**0.072*****	**0.070*****			0.74	117.99	1.39
11					**0.038*****			**-0.015*****		**0.224*****	**0.147*****				0.88	119.89	1.90
12		**-0.780*****			**0.041*****	**0.038*****	**0.030*****	**0.008****		**0.069*****	**0.085*****	**0.037*****			0.88	140.29	1.75
13	**0.810***	**1.352***			-0.052					**0.197*****			**0.347*****		0.73	96.93	2.13
14	**0.609*****				0.006	**0.017*****					**0.144*****	**0.192*****			0.90	126.89	1.59
Mean	0.598	1.441	0.063	0.189	0.006	0.024	0.021	-0.007	-0.002	0.117	0.110	0.049	0.164	0.317			
Std. Dev.	0.957	2.766	0.255	0.302	0.067	0.014	0.011	0.013	0.001	0.050	0.054	0.103	0.244				
Groups of banks (Fixed Effects):																	
SOCBs				**0.191****	**0.014****	0.029***	**0.007****		0.000***	0.103***	0.018	**0.015***	**0.162****		0.79	490.97	2.05
JSCBs	**0.827*****	**0.966****	**0.116****		**-0.023***	**0.007***	**0.016*****		**-0.001*****	**0.120*****	**0.084*****			**0.323*****	0.69	734.84	2.06
CCBs	**0.331***				0.019	**0.020*****	**0.012****			**0.100*****	**0.110*****	**0.082*****			0.60	294.67	1.65
G-SIBs				**0.206*****	0.006	**0.027*****			**0.000*****	**0.090*****			**0.370*****		0.78	377.68	2.15
G-SUIBs	**0.435*****	**0.647***	**0.114***	0.033	-0.009	**0.013*****	**0.019*****	0.004	**-0.001*****	**0.116*****	**0.086*****	**0.014***		**0.321*****	0.65	1113.80	1.91

Note: * denotes significance at the 10% level, ** at the 5% level, and *** at the 1% level.

6 Conclusion

We study Chinese bank lending for a panel of 14 Chinese banks over the decade following the global financial crisis. In doing so, we investigate the degree to which bank lending is driven by economic factors or a set of bureaucratic, deterministic variables. We find significant effects on bank lending through both economic and bureaucratic variables, based on pooled fixed-effects estimates. The impact of economic factors is less significant in heterogeneous panels. This suggests significant exposure of joint-equity banks and global systemically unimportant banks to market forces. Bank lending through systemically relevant and state-owned commercial Chinese banks hence appears to be rather driven by policy and "too-big-to-fail" effects than commercial considerations.

These results suggest that, whilst there remains a large degree of state influence on Chinese banks, there is evidence for market exposure even at a time of unprecedented state interventions following the global financial crisis. Using new data that allows exploring the heterogeneity of the Chinese banking system, we thus find crucial evidence for the development of the Chinese banking system into a market economy. Further promising research could attempt to compare the results on bank specific factors with that for US banks, to compare the degree to which market factors affected bank lending in a developed market economy post 2008. It will also be interesting to see if the pattern of bank lending remains the same in the future if Chinese growth is slower.

This research is a starting-point towards evaluating Chinese financial development. It will be interesting to investigate this from a macroeconomic perspective, analysing how the interaction of key macro-economic aggregates resembles aggregate goods and money supply and demand relationships.

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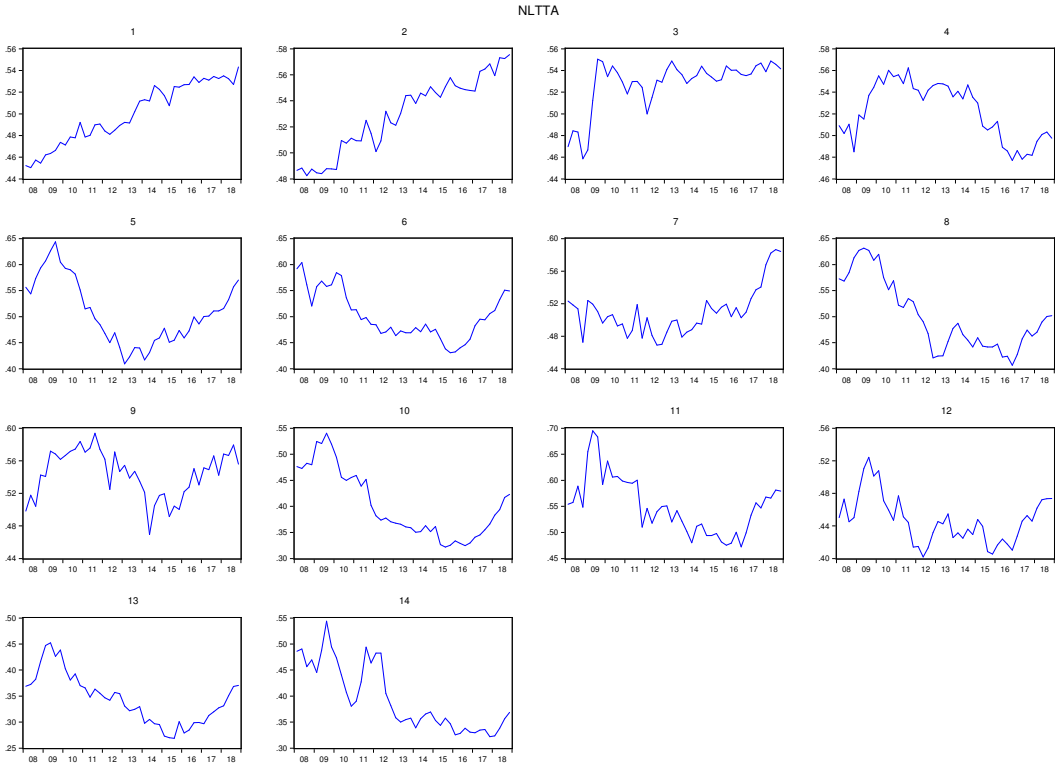
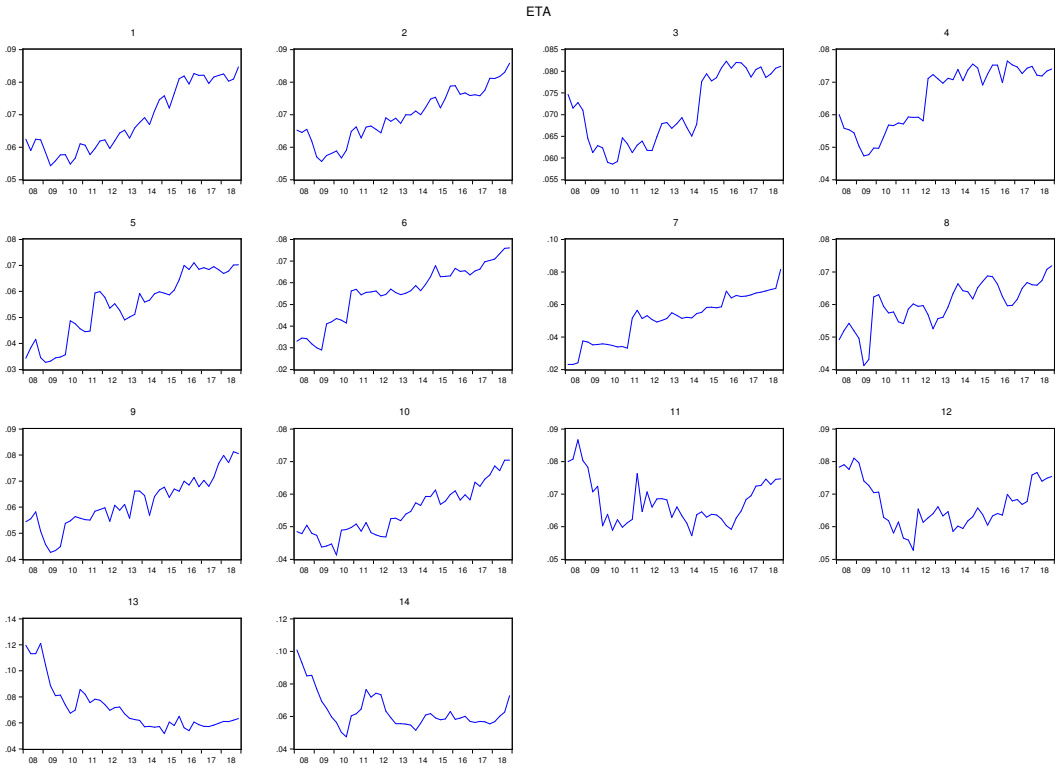
A Appendix: Patterns of bank-specific variables

Figure 3: NLTTA: Ratio of Net Loans and Receivables to Total Assets.



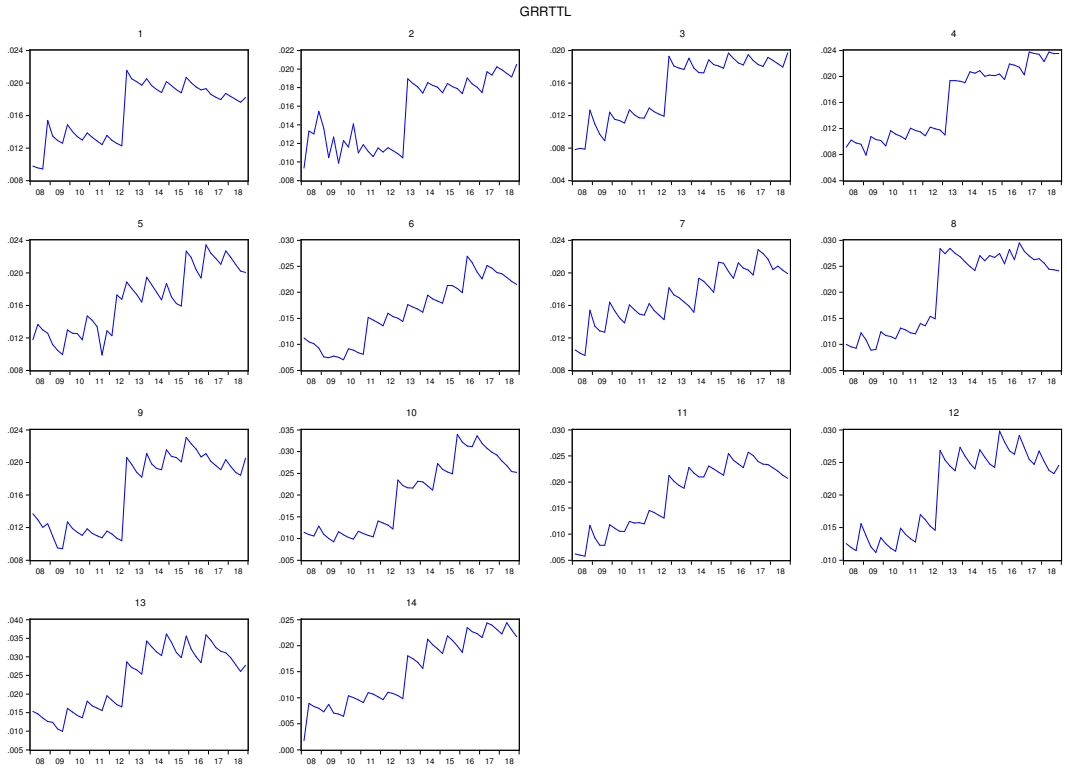
Note: The number at top of each subgraph corresponds to the crossid of each bank listed in Table 1.

Figure 4: ETA: Ratio of Equity to Assets.



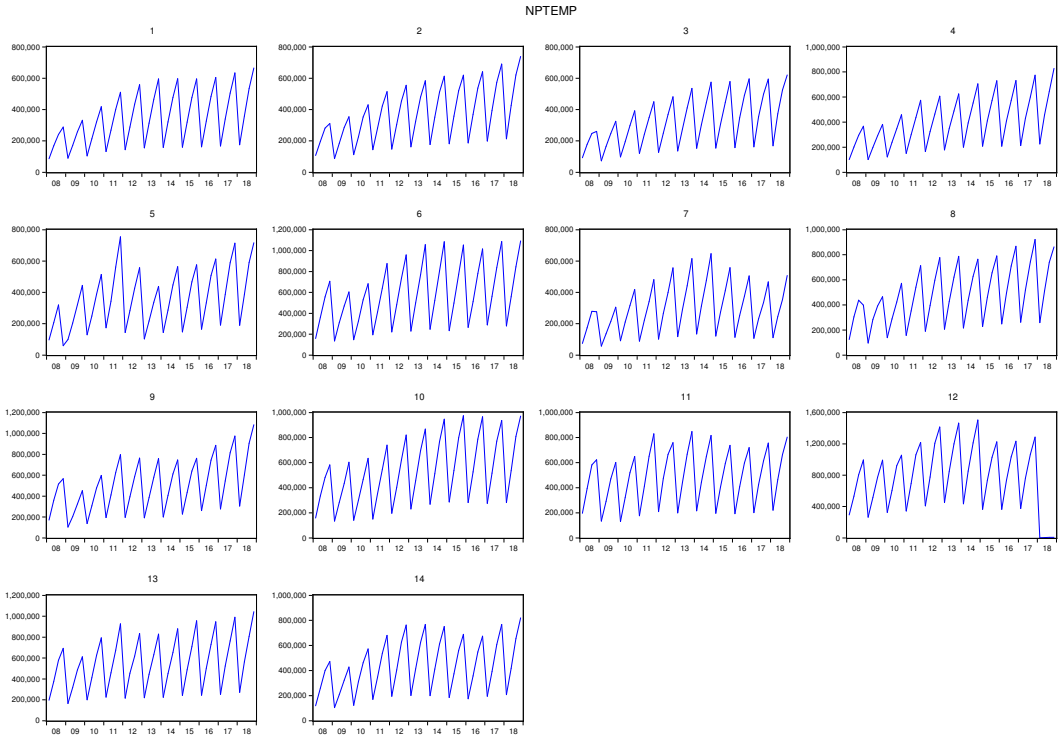
Note: The number at top of each subgraph corresponds to the crossid of each bank listed in Table 1.

Figure 5: GRRTTL: Ratio of General Risk Reserves to sum of General Risk Reserves and Net Loans And Receivables.



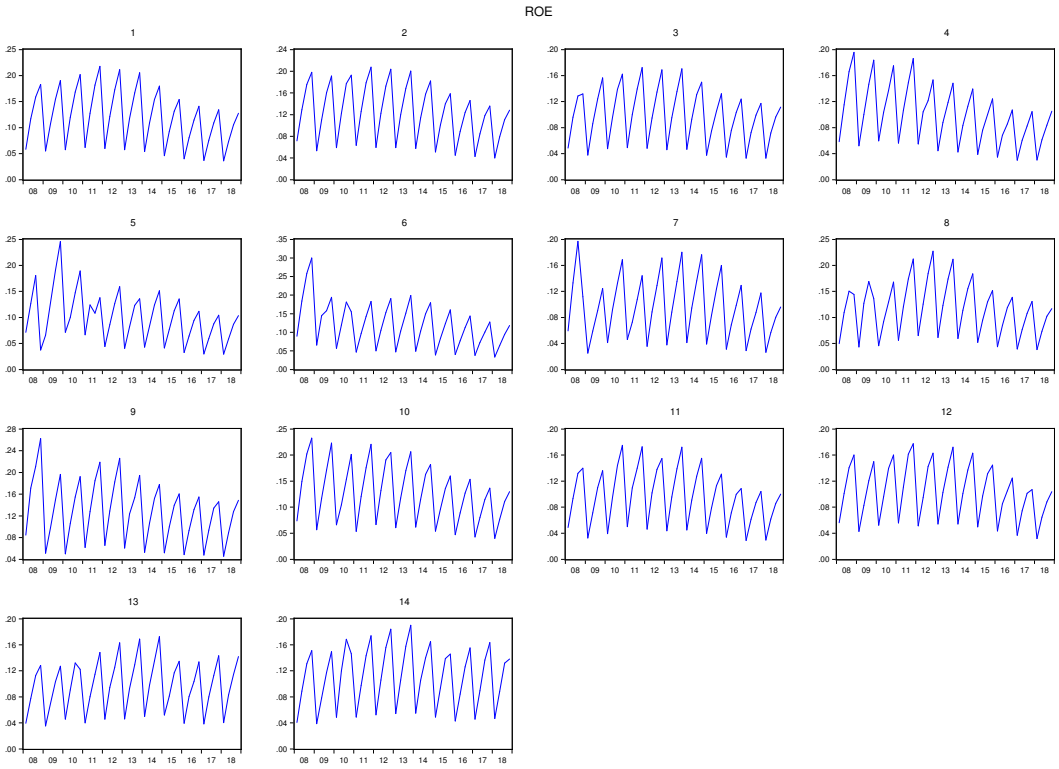
Note: The number at top of each subgraph corresponds to the crossid of each bank listed in Table 1.

Figure 6: NPTEMP: Net Profits per Employee.



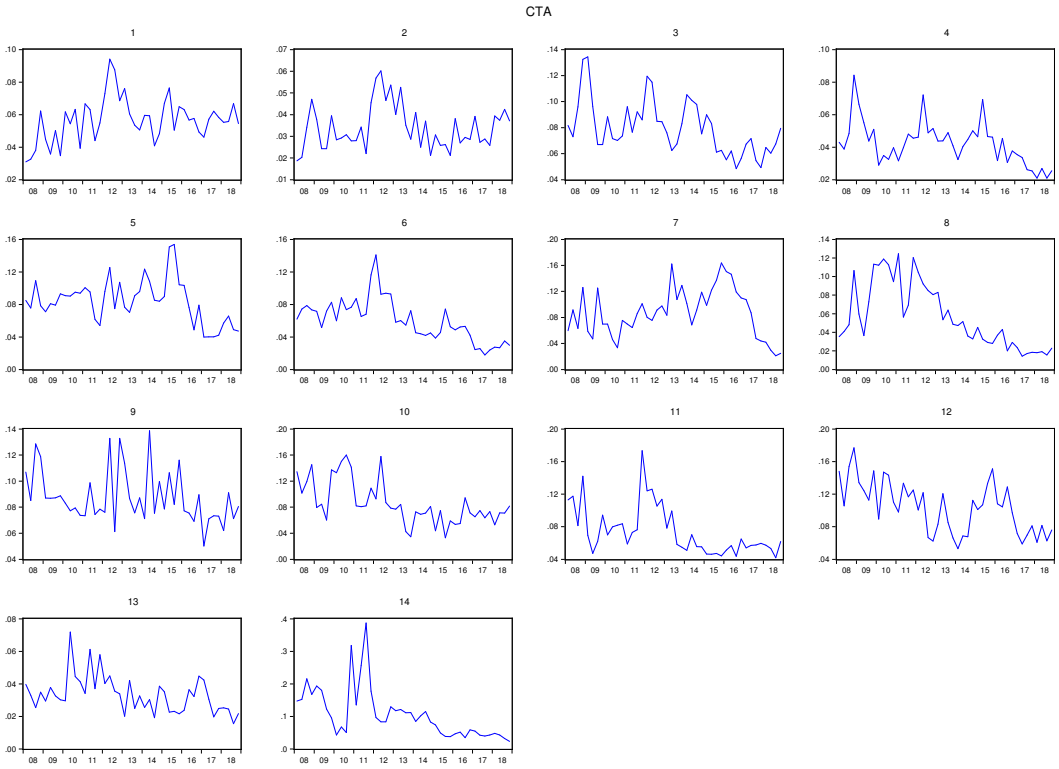
Note: The number at top of each subgraph corresponds to the crossid of each bank listed in Table 1.

Figure 7: ROE: Return on Equity.



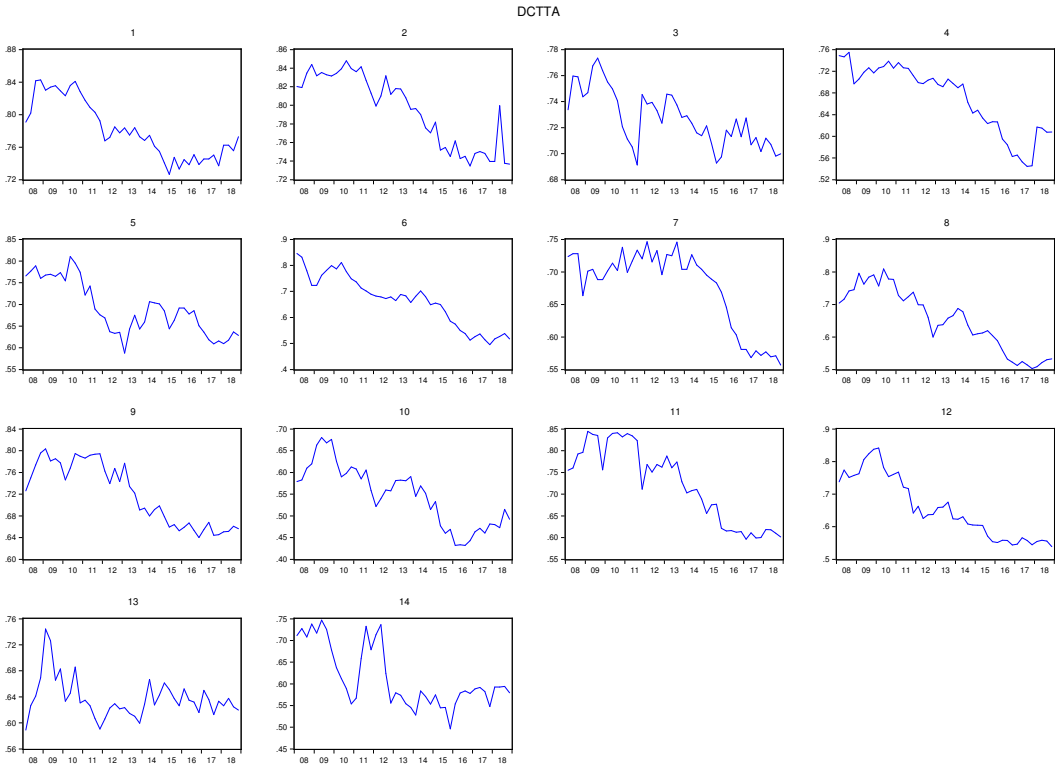
Note: The number at top of each subgraph corresponds to the crossid of each bank listed in Table 1.

Figure 8: CTA: Ratio of Cash to Assets.



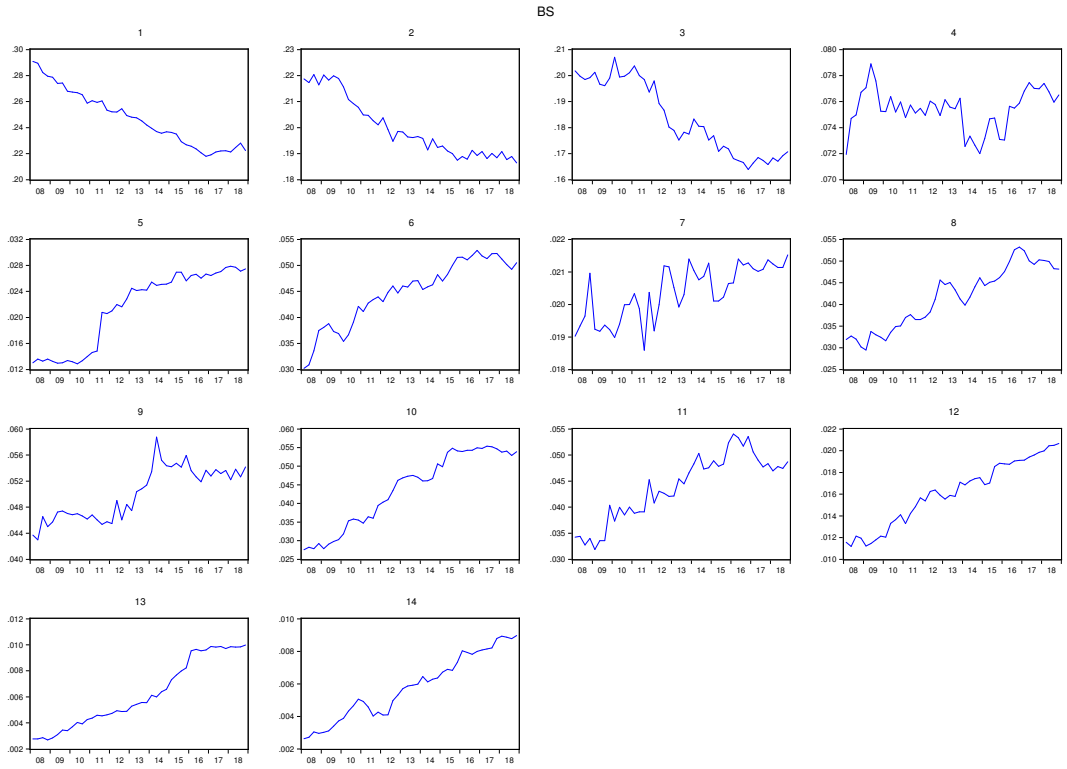
Note: The number at top of each subgraph corresponds to the crossid of each bank listed in Table 1.

Figure 9: DCTTA: Deposits Due To Customers to Total Assets.



Note: The number at top of each subgraph corresponds to the crossid of each bank listed in Table 1.

Figure 10: BS: Bank size.



Note: The number at top of each subgraph corresponds to the crossid of each bank listed in Table 1.

B Appendix: Diagnostics of baseline general specifications

Table 10 shows three diagnostic tests for the baseline general specifications including redundant variable test, ommitted variable test, and residual normality test.

The first column gives the P values for a F test of the joint significance of the economic variables in the baseline general model. The null hypothesis is that ETA(-1), GRRTTL(-1), ROE(-1), and CTA(-1) are jointly insignificant. For the individual banks, the economic variables are only significant at the 5% level in Bank 10, the Industrial Bank Co., Ltd. and at the 10% level in 4 banks. For 10 of the 14 banks the economic variables are not significant. They are significant in pooled groups: JSCBs (joint-equity banks). They are also significant when the 14 banks are pooled using the fixed effect estimator, probably because the larger sample size has reduced the standard errors.

We have assumed one lag of the economic variables in the baseline general model. The second column gives the P values for a F test for adding a second lag. The null hypothesis is that ETA(-2), GRRTTL(-2), ROE(-2), and CTA(-2) are jointly significant. The second lag is significant at the 5% level only in 2 banks: the bank 1 and 12, and at the 10% level in the bank 3. Among the groups it is significant at the 1% level in G-SIBs and 10% level in group SOCBs. Thus there is relatively little evidence to include a second lag of economic variables in the

model. This is also evidence against second order serial correlation being important.

The third column gives P values for normality tests. Only 2 of the 14 banks fail the normality test but the heterogeneity among the banks means that all the groups and the pooled estimates fail the normality test. These tests suggest that our general specifications for the individual banks are reliable.

Table 10: Baseline general specifications, diagnostic tests. Dependent variable: NLG.

Test	**Redundant variables test**	**Omitted variable test**	**Residual normality test**
F-statistic	**P-value**	**P-value**	**P-value**
Fixed Effects Panel			
14 banks	**0.000**	0.608	**0.000**
Individual banks (crossid)			
1	0.737	**0.012**	0.272
2	0.756	0.338	0.260
3	0.707	**0.079**	0.766
4	**0.071**	0.130	0.111
5	**0.065**	0.310	**0.000**
6	0.351	0.891	0.933
7	0.412	0.103	0.544
8	0.409	0.300	0.152
9	**0.070**	0.824	0.880
10	**0.001**	0.297	0.728
11	0.907	0.276	0.964
12	0.341	**0.022**	0.856
13	0.756	0.957	**0.000**
14	0.607	0.379	0.286
Groups of banks (Fixed Effects)			
SOCBs	0.168	**0.058**	**0.000**
JSCBs	**0.000**	0.472	**0.000**
CCBs	0.450	0.210	**0.000**
G-SIBs	0.115	0.003	**0.000**
G-SUIBs	0.001	0.508	**0.000**

Note: The bold green numbers denotes significance at the 10% level; the bold blue numbers at the 5% level; and the bold red numbers at the 1% level.